

**GOLDEN'S DIAGNOSTIC RADIOLOGY**  
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**Section 18:**  
**SELECTIVE**  
**ANGIOGRAPHY**

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tion, a slight aspiration should always be performed to remove any air bubbles that might be present in the hub of the catheter.

Manipulation of the catheter should be performed with fluoroscopic control and any substantial advancement should be made with a guide wire leading. There are four major movements that an angiographer can apply during selective catheterizations: (1) rotation, (2) advancement, (3) withdrawal, and (4) sawing. The latter refers to use of a repeated slight advance and then withdrawal motion of the catheter. These movements must be applied carefully although frequently in combination with each other. Likewise, appropriate use of a guide wire during manipulation is helpful to reduce the flexibility of the catheter and change the preformed curves when necessary.

Small test injections of 1-5 ml. of contrast media should always be performed to ascertain a free catheter position, but only if blood may be freely aspirated. When the catheter is selectively positioned in a small artery, a forceful injection of saline under fluoroscopic observation is used to test for possible recoil prior to the actual injection of contrast medium for the definitive study.

For selective angiography, hand injections are usually satisfactory for adequate delivery of the contrast bolus; however, the use of a mechanical or pressure injector does not increase the risk when properly employed and appropriate delivery times are used. In addition, coordinating an injector with the serial filmer will enhance the quality of studies because of greater reliability and accuracy in filming. If a flow-rate injector is not being used, delivery rates with the particular catheter systems employed must be determined by the angiographer experimentally.

Filming sequences are largely up to the preference of the angiographer, but also depend upon the formation needed in reference to the arterial, capillary, and venous phases and the vascular bed to be studied. It cannot be overemphasized that close coning of the x-ray beam, particularly with fluoroscopic control, is essential for maximum detail.

Following completion of the procedure, the catheter is best removed with the patient in his own bed so that there need be no further motion of that extremity. Prior to removal of the catheter, a vasodilator such as procaine should be injected into the catheterized artery if there is any evidence of spasm (Howland *et al.*, 1967). With removal of the catheter, a short spurt of blood should be allowed as manual pressure may trap any clots that have formed around the catheter tip. Pressure should be applied at the actual arterial puncture site rather than just over the skin incision. The pressure should be just hard enough to prevent bleeding and preferably should still allow the pulsation of the vessel peripherally (radial or dorsal pedal arteries) to be felt. The time of pressure is dependent on the size of the catheter used, the length of the procedure, and the age and blood pressure of the patient. The use of gauze interposed between the fingertips and the artery is to be avoided as a hematoma may easily arise without being noted by the angiographer. The pulsation of the artery being compressed should be palpable at all times. Following compression, the use of a pressure bandage is recommended at least in cases where delayed bleeding is a significant risk, such as in patients with severe systemic hypertension and aortic insufficiency in whom there is a very wide pulse pressure and in patients where the procedure was unusually prolonged. The patient should be placed at complete bed rest for at least 6 hr. and longer if indicated. The status of the extremity and puncture site as well as the distal pulsations should be followed carefully. If the axillary or brachial artery has been catheterized, the arm is kept abducted and extended for 2-3 hr. prior to laying it across the patient's chest.

## COMPLICATIONS

### Contrast Agent Toxicity

Complications can be divided into two general types—that due to the contrast agent and that due to the procedure of catheterization. It may be remembered from the previous discussion of contrast agents